



SCALLOP FISHERY AREA/TIME CLOSURE TO PROTECT COD SPAWNING AGGREGATIONS IN 5Z (GEORGES BANK)

Context

The requirement to account for all fishing mortality of Georges Bank cod (*Gadus morhua*) in Canada has led to efforts by the offshore scallop fishery to reduce cod bycatch. Along with active avoidance protocols adopted by the offshore scallop fleet, DFO has implemented area/time closures from early February to the end of March since 2005 in order to reduce bycatch and minimize disturbance to spawning aggregations of cod by the offshore scallop fishery on Georges Bank. To assist resource managers in determining appropriate area closures for the offshore scallop fishery on Georges Bank during the cod spawning seasons, fisheries management asked the following question: "What does a review of 5Z cod distribution, particularly at spawning time, reveal about the spatial and temporal trends of the species and its overlap with the offshore scallop fishery? Highlight areas of high 5Z cod distribution using the cells which have already been defined and used in previous years." This document provides the requested information on the spatial distribution of cod abundance and its overlap with scallop catches on Georges Bank. It concludes that implementing a cod area/time closure for 2013 which reflects the recent 10-year time period (2003-2012) should achieve the objective of reducing cod bycatch and disturbance of spawning aggregations, since a comparison of the recent distribution to that from the beginning of the time series (1996) shows that a change has occurred.

This Science Response Report results from the Science Special Response Process of January 2013 on the Review of Scallop Fishery Closure to Protect Cod Spawning Aggregations on Georges Bank in 2013, which was conducted by email. It is an update of information provided annually from 2006 to 2009 in the Maritimes Region's Expert Opinions series and from 2010 onward in the Canadian Science Advisory Secretariat (CSAS) Science Response series.

Analysis and Response

The 2012 first quarter offshore scallop catches on Georges Bank correspond to approximately 6% (235 tonnes of meats) of the total allowable catch for the year, which is below the long term average percentage for the first quarter (17% since 1990). At the start of the 2012 fishery, there were two industry managed juvenile scallop closure areas in place. In October of 2012, an additional closure area was added and one of the existing areas was slightly modified. These current closure areas are outlined in red in Figures 1, 2 and 3.

The analysis used to provide this information has been updated with the 2012 cod abundance data, obtained from the annual DFO Research Vessel (RV) survey, and scallop catches from the offshore scallop fishery logbooks. Details on the methods for this analysis can be found in the Maritimes Region Science Expert Opinion 2006 (DFO, 2006). Information from the DFO RV survey conducted during late February/early March was used to identify areas of high aggregations of adult (age 3+) cod. The distribution of age 3+ cod was plotted on a 5-minute

longitude by 3.33-minute latitude cells (~12.5 nautical miles² or 43 km² per cell). The number of cod per cell was determined using 2 methods: 1) the average number for all RV survey tows within a cell and 2) the “standardized” average number per tow for all RV survey tows within a cell. Data were “standardized” by first dividing the number per tow by the average number per tow on an annual basis and then averaging these values over the applicable time series. This has the effect of diluting the influence of very large tows and reducing between year variability. Two scenarios were examined: 1) using data from the last 10-year period (2003-2012) and 2) using all available data (1996-2012, 17-year period).

Under Scenario 1, the high cod aggregation areas for the last decade, i.e. cells with greater than 50 (or 3.5 standardized) age 3+ cod, numbered 1 to 13 (14 cells greater than 3.5 using the “standardized” method) in order of decreasing abundance (Figure 1), were compared to 2012 first quarter scallop catches in those areas (Table 1). Under Scenario 2, the high cod aggregation areas for the last 17 years, i.e. cells with greater than 50 (or 3.5 standardized) 3+ cod, numbered 1 to 16 (11 cells greater than 3.5 using the “standardized” method) in order of decreasing abundance (Figure 2), were compared to 2012 first quarter scallop catches in those areas (Table 2).

Scenario 1 (Figure 1, upper chart) shows general continuity in the location of high ranking cells with the 10 year scenario from the 2012 analysis (DFO, 2012), but with a reduction in the number of cells with greater than 50 3+ cod (14 cells in the 2012 analysis versus 13 cells in the current year). Most of the high ranking cells are in the same location as the previous year’s analysis, although the order has changed and two cells have been dropped (7 & 10 from the 2012 analysis) and the most easterly cell (cell 13 Figure 1, upper chart, or cell 7, Figure 1, lower chart) in the current analysis has been added (Figure 1; DFO, 2012). The top two highest ranking cells from the 2012 analysis (Figure 1; DFO, 2012) are also the highest cells in the current year’s analysis using the first method. The high ranking cells in the “standardized” method are located similarly as for the first method but, after the highest ranking cell, the order of the ranking is different. There are several high ranked cells for 3+ cod abundance in more dispersed locations as well, as there was in 2012. Notable are cells 3 (5), 4 (11), 6 (4) and 13 (7) for the first method (and “standardized” method).

Scenario 2 cell locations included in the highest ranking for age 3+ cod abundance are the same as those observed in the analysis conducted in 2012 for cells 1 through 12 (Figure 2, DFO, 2012). In this year’s analysis, the most westerly cell has dropped off but the remaining 4 cells are the same as the 2012 analysis and in the same order (Figure 2; DFO, 2012). The “standardized” method (Figure 2, lower chart) clusters the 11 highest ranking cells in the middle of the bank, similarly to the first method but the order is different and one cell (6 in the first method) is excluded. This scenario has shown stability from year to year as current data is added. Scenario 2 continues to show an aggregation of age 3+ cod in the center of the bank with high ranking cells generally grouped together (11 cells total, Figure 2, lower chart).

Currently the strongest aggregation of cod for both scenarios occurs in an area near the center of the bank; however, the shorter scenario (scenario 1, Figure 1) indicates that there are also noteworthy aggregations of 3+ cod on the northern part of the bank (especially cell 3, Figure 1 upper chart) and in several isolated locations. Although there are annual variations in the distribution of the 3+ cod abundance and aggregations have been consistently observed in the area near the center of the bank, the highest ranking cells from the two scenarios are no longer similar spatially. Most notable is the dropping of cells 1, 4, 6, and 8 of Scenario 2 from Scenario 1 for the first method (upper charts in Figures 1 and 2). A similar change is observed in the “standardized” method (lower charts in Figures 1 and 2). The longer time series presented in scenario 2 may no longer reflect the current cod distribution on Georges Bank.

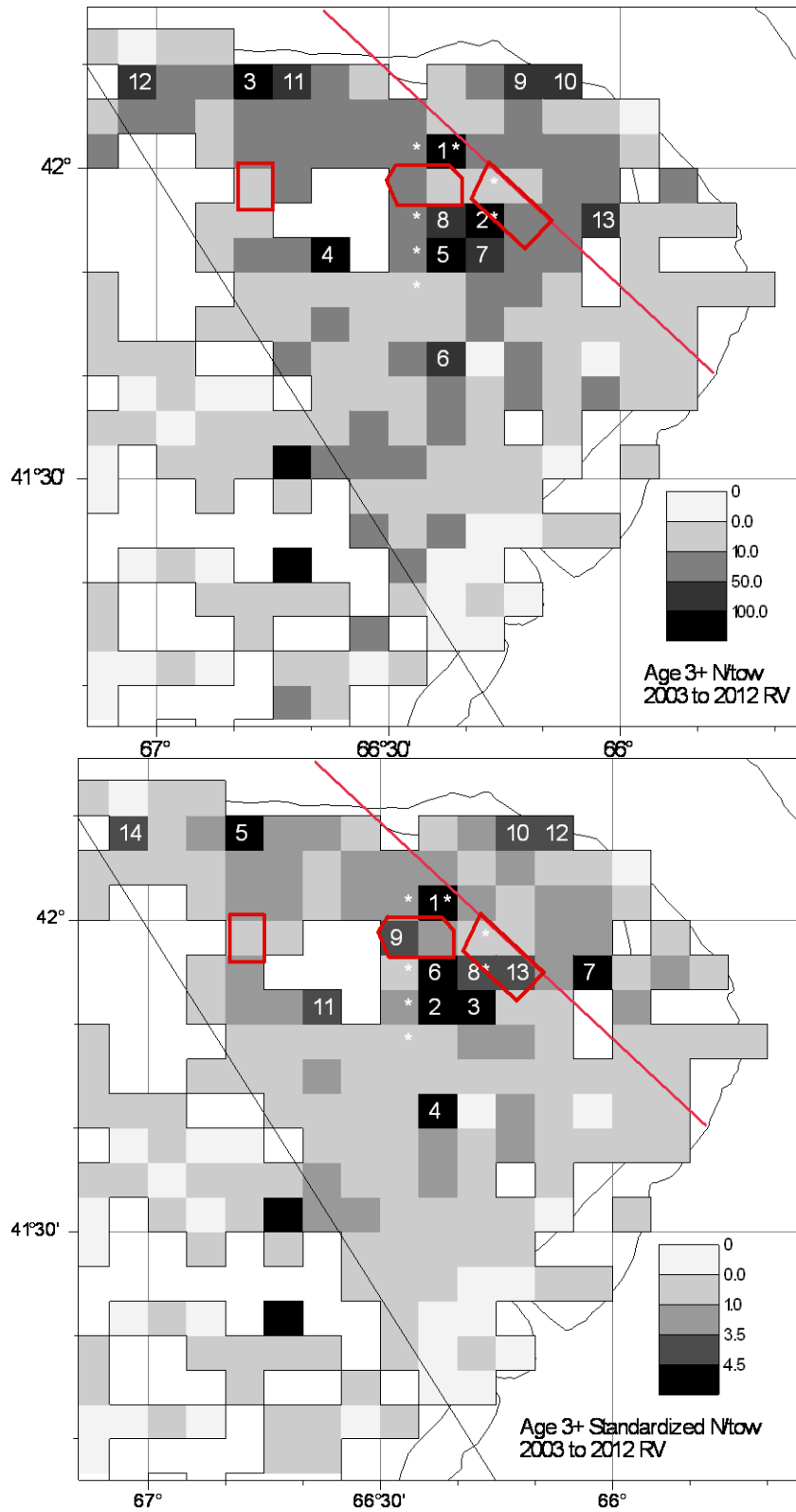







Figure 1. Scenario 1 - Distribution of aggregated age 3+ cod from RV data for the period of 2003 to 2012. In the upper figure cells on the Canadian side with 50+ adult cod per cell have been ranked in descending order. The N/tow in the lower figure have been standardized by dividing the N/tow by the average N/tow on an annual basis. Ranked cells in the lower figure have values greater than 3.5 standardized N/tow. Cells that were part of the 2012 cod closure are indicated by an asterisk (*). The 3 current industry initiated scallop fishery closure areas are outlined in red.

Table 1. Scenario 1 - Association between first quarter scallop catch (tonnes of meats) by the offshore scallop fleet and cells of high cod density (cells with 50 or more age 3+ cod on average in Feb.-Mar. RV survey data). The cod cells, numbered 1 to 13, are in descending order of cod abundance. The cells from the standardized method, along with the respective scallop catch, are provided in the last two rows and correspond to the same cells in the top row. Grey scale rankings indicate the abundance of scallop catch that corresponds to each cell of high cod density.

Year/Cod Cell No.	1*	2*	3	4	5	6	7	8	9	10	11	12	13		
2003		10			0		10	0				25			
2004	25	10	0	0	0		10	0							
2005		0		0		0		0				0			
2006	0											0			
2007	0		0		0		0	0				0			
2008	25	25	0				25				10	0			
2009	25	0	0	0	0	0	0	0				10			
2010		0	0	0	0	0	0					10			
2011	0	0	0		0		25	0			0	25			
2012	0	0			10		10	10				0			
cells (standardized)	1*	8*	5	11	2	4	3	6	10	12		14	7	9	13
2012	0	0			10		10	10				0		0	10

* indicates cells that were part of the 2012 closure (Note: closure included 4 cells that are not represented here)

Legend: ScallopCatch

Color	Scallop Catch (t of meats)
	catch ≥ 50
	25 = catch < 50
	10 = catch < 25
	0 < catch < 10
	catch = 0

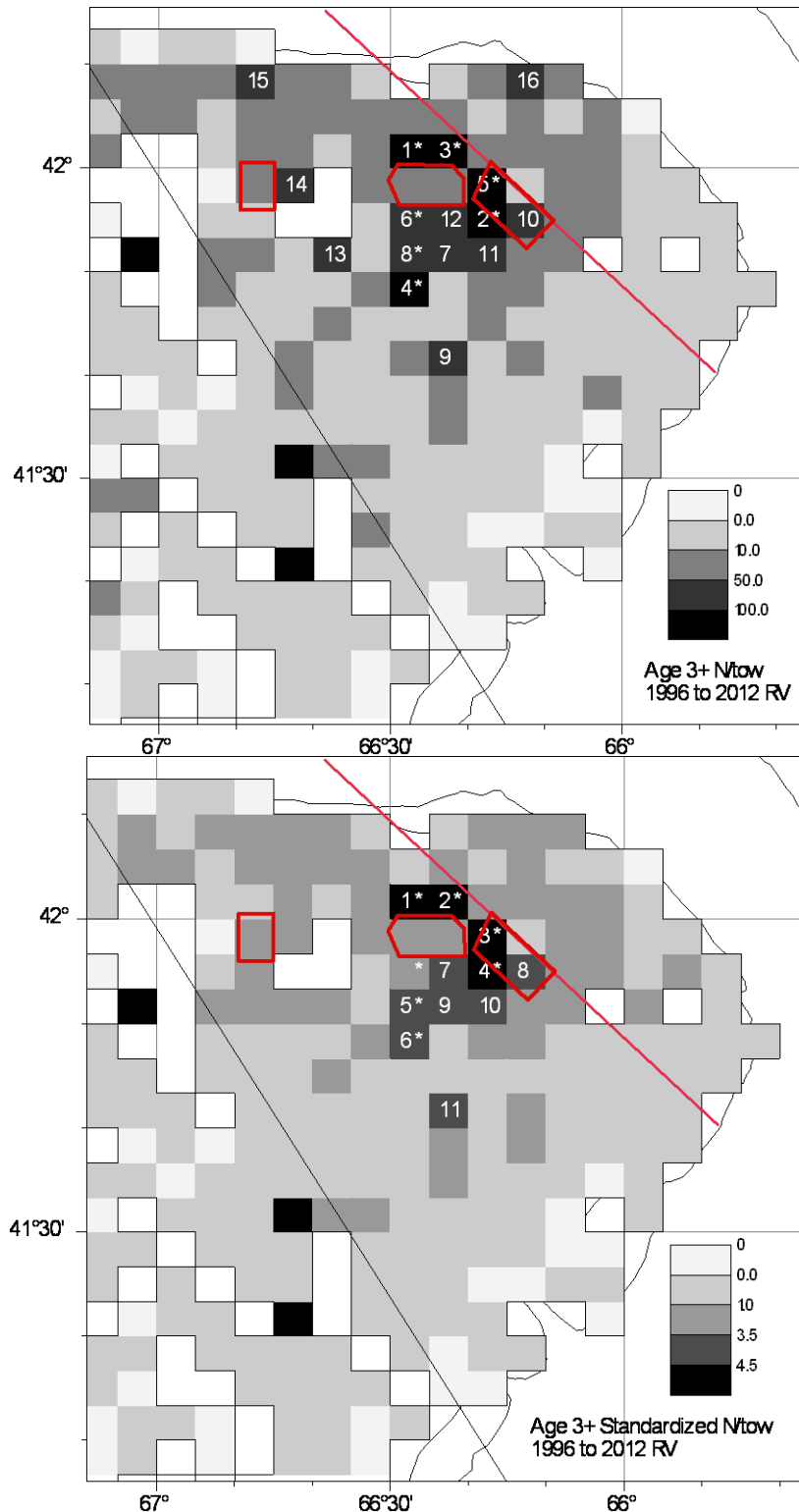







Figure 2. Scenario 2 - Distribution of aggregated age 3+ cod from RV data for the period of 1996 to 2012. In the upper figure cells on the Canadian side with 50+ adult cod per cell have been ranked in descending order. The N/tow in the lower figure have been standardized by dividing the N/tow by the average N/tow on an annual basis. Ranked cells in the lower figure have values greater than 3.5 standardized N/tow. Cells that were part of the 2012 cod closure are indicated by an asterisk (*). The 3 current industry initiated scallop fishery closure areas are outlined in red.

Table 2. Scenario 2 - Association between first quarter scallop catch (tonnes of meats) by the offshore scallop fleet and cells of high cod density (cells with 50 or more age 3+ cod on average in Feb.-Mar. RV survey data). The cod cells, numbered 1 to 16, are in descending order of cod abundance. The cells from the standardized method, along with the respective scallop catch, are provided in the last two rows and correspond to the same cells in the top row. Grey scale rankings indicate the abundance of scallop catch that corresponds to each cell of high cod density.

Year/Cod Cell No.	1*	2*	3*	4*	5*	6*	7	8*	9	10	11	12	13	14	15	16
1996	Yellow	Yellow	Blue	Blue	Blue	Yellow	Blue	Blue	Blue	Blue	Blue	Yellow	Blue	Blue	Blue	Blue
1997	Blue	Blue	Blue	Blue	Orange	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue
1998	Yellow	Blue	Yellow	Blue	Yellow	Yellow	Blue	Blue	Blue	Yellow	Blue	Blue	Blue	Blue	Blue	Blue
1999	Blue	Blue	Yellow	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Orange	Blue	Blue
2000	Red	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Yellow	Blue	Blue
2001	Red	Yellow	Blue	Yellow	Blue	Orange	Blue	Yellow	Blue	Blue	Yellow	Yellow	Blue	Yellow	Blue	Blue
2002	Blue	Orange	Blue	Blue	Yellow	Blue	Blue	Blue	Blue	Red	Orange	Blue	Blue	Orange	Blue	Blue
2003	Blue	Yellow	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Orange	Yellow	Blue	Blue	Yellow	Blue	Blue
2004	Yellow	Yellow	Orange	Blue	Yellow	Blue	Blue	Blue	Blue	Blue	Yellow	Blue	Blue	Blue	Blue	Blue
2005	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Yellow	Blue	Blue
2006	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue
2007	Red	Blue	Blue	Blue	Blue	Red	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue
2008	Orange	Red	Red	Blue	Red	Orange	Blue	Blue	Blue	Red	Red	Blue	Blue	Blue	Blue	Blue
2009	Orange	Blue	Red	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Orange	Blue	Blue
2010	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Orange	Blue	Blue
2011	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Orange	Blue	Blue	Blue	Blue	Blue
2012	Blue	Blue	Blue	Blue	Blue	Blue	Yellow	Blue	Blue	Yellow	Yellow	Yellow	Blue	Blue	Blue	Blue
cells (standardized)	1*	4*	2*	6	3		9	5	11	8	10	7				
2012	Blue	Blue	Blue	Blue	Blue	Blue	Yellow	Blue	Blue	Yellow	Yellow	Yellow	Blue	Blue	Blue	Blue

* indicates cells that were part of the 2012 closure (Note: closure included 4 cells that are not represented here)

Legend: ScallopCatch

Color	Scallop Catch (t of meats)
	catch ≥ 50
	25 = catch < 50
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	catch = 0

Conclusions

The closure area for the past six years has covered a similar geographical area, which was based on the full time series (scenario 2). This longer time series (1996 to 2012, Figure 2) may no longer reflect the current cod distribution on Georges Bank as it is more similar to the 1996 to 2005 (Figure 3) distribution than the most recent 10 years (2003 to 2012) (Figure 1). The past closures encompass a cluster of cells which includes 7 high ranking cells, for both methods, for the first 10-year period (1996 to 2005 period; Figure 3). To more fully reflect the current cod distribution, a cod area/time closure for 2013 should be based on the 2003 to 2012 cod distribution as there has been a change in the distribution from the first 10 years of the time series (1996 to 2005) to the last 10 years (2003 to 2012) which the 17 year distribution does not capture. This should achieve the objective of reducing cod bycatch and disturbance of spawning aggregations. The 2012 first quarter scallop landings in the 6 highest ranked non-standardized cells were 18.93 mt and 10.07 mt for scenarios 1 and 2, respectively. The closure cells selected in 2012 had a total of 10.82 mt first quarter scallop landings prior to the closure beginning on February 6, 2012. A closure based on the top ranking cells (1 to 6) from scenario 1 (non-standardized) would also have a relatively low impact on the offshore scallop fishery. This may be due in part to cod area/time closures in the past few years during the first quarter, dispersing the scallop fishery effort to other locations. However, the 6 top ranking standardized cells for scenario 1 would have a considerably higher impact (48.62 mt during the same time period).

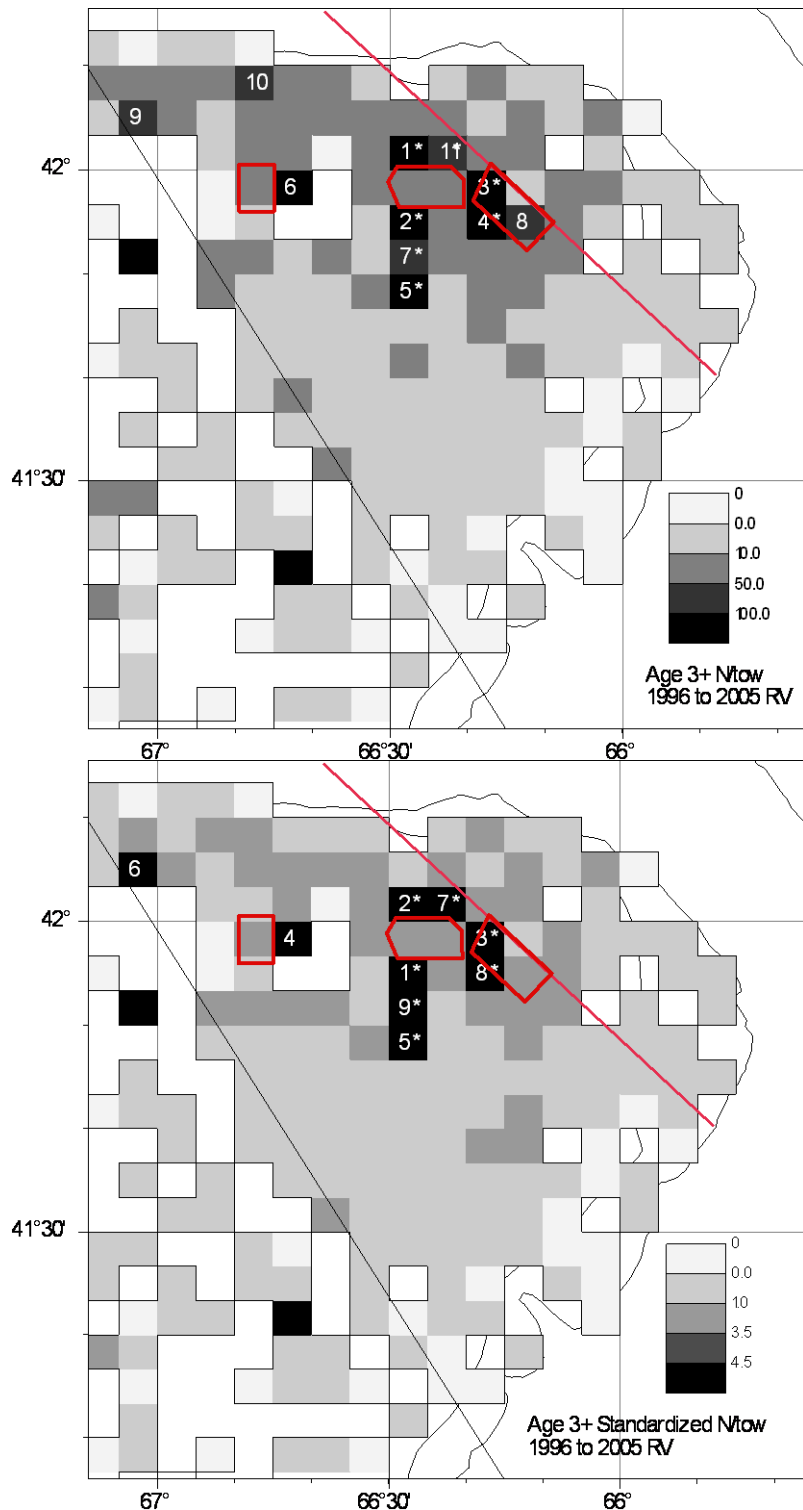


Figure 3. Distribution of aggregated age 3+ cod from RV data for the period of 1996 to 2005. In the upper figure cells on the Canadian side with 50+ adult cod per cell have been ranked in descending order. The N/tow in the lower figure have been standardized by dividing the N/tow by the average N/tow on an annual basis. Ranked cells in the lower figure have values greater than 3.5 standardized N/tow. Cells that were part of the 2012 cod closure are indicated by an asterisk (*). The 3 current industry initiated scallop fishery closure areas are outlined in red.

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Sources of Information

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DFO. 2012. Scallop Fishery Area/Time Closure to Protect Cod Spawning Aggregations in 5Z (Georges Bank) in 2011. DFO Can. Sci. Advis. Sec. Sci. Resp. 2012/011.

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